

RSRM

Propellant Grain

Geometry Modification

RSRM Propellant Grain Geometry Modification

• Objective

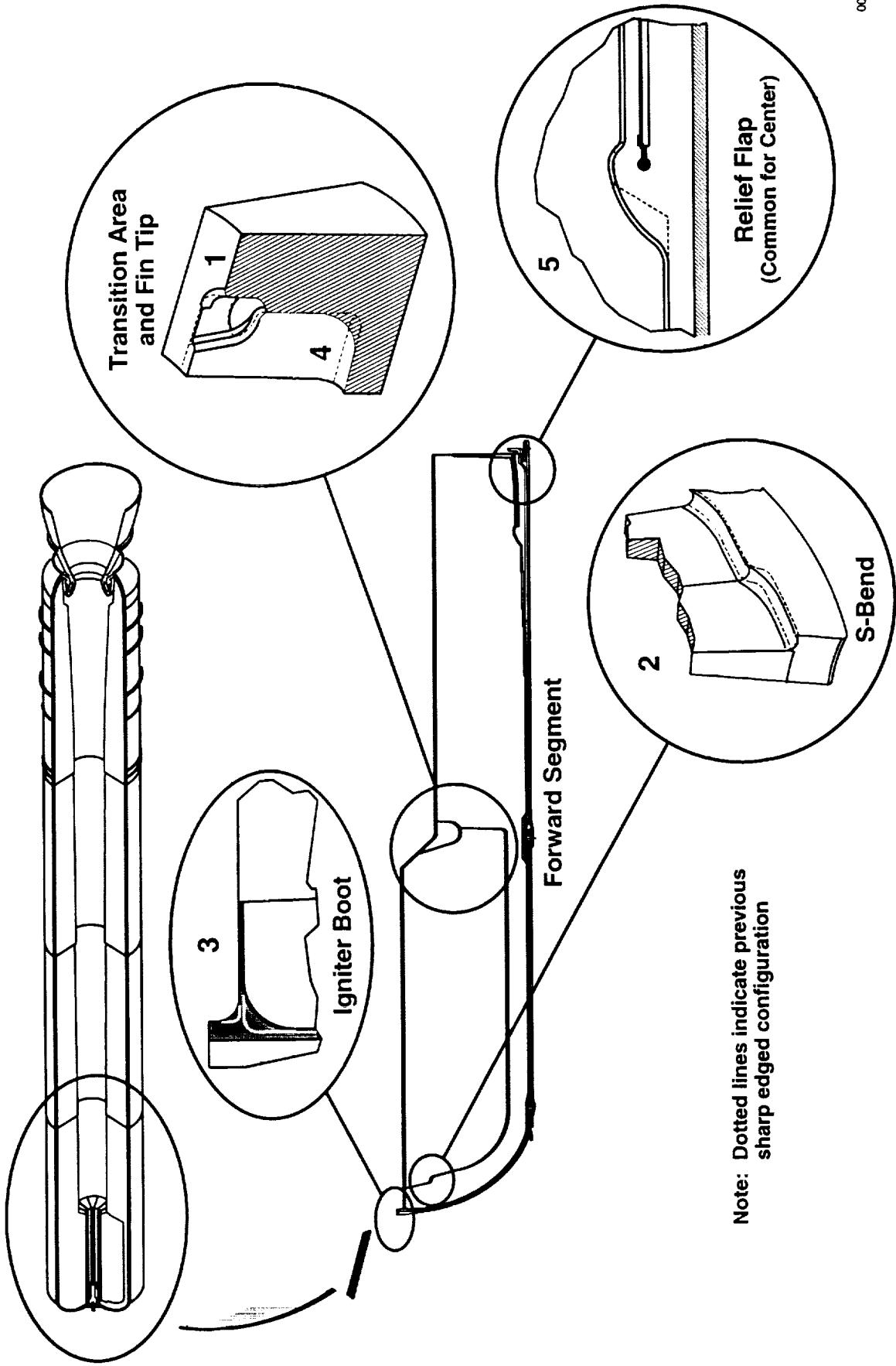
- *IMPROVE PERSONNEL AND SYSTEM SAFETY* by modifying propellant grain geometry to improve structural factors of safety
 - Personnel risk; exposure to hazardous operations
 - Potential system risks; over pressurization and premature flame at case wall

• Background

- CEI specification structural requirements for propellant grain are below a 2.0 safety factor due to localized induced loads. Five regions exist:

Region	Current SF	Upgrade SF Requirement	Controlling CEI Condition
1. Transition Area	1.4	>2.0	Transportation $\leq 28^{\circ}\text{F}$
2. S-bend	1.4	>2.0	Storage $\leq 40^{\circ}\text{F}$
3. Igniter Boot	1.6	>2.0	Launch $\leq 40^{\circ}\text{F}$
4. Fin Tip	1.4	>2.0	Storage $\leq 40^{\circ}\text{F}$
5. Fwd & Ctr Flap Terminus	1.4	>2.0	Storage $\leq 40^{\circ}\text{F}$

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- Propellant/liner/insulation modification will...

- Reduce high-stress or strain regions in the propellant grain by reducing sharp corners in the geometry
 - Modify grain forming tooling
 - Modify insulation lay-up
- Reduce the time operators and inspectors at Thiokol and KSC spend in a hazardous environment inside the motor
 - Significantly reduce propellant trimming and associated inspections in the areas of profile changes
 - Eliminate the re-inspection criteria at KSC after 6 months storage and any rotation operation to accomplish the inspection
 - Increase schedule flexibility at KSC
- Enhance risk mitigation to include both inspection and design
 - Provide a more robust structural design, less sensitive to variation (obsolescence driven raw material changes, nonconformances, and contamination issues)

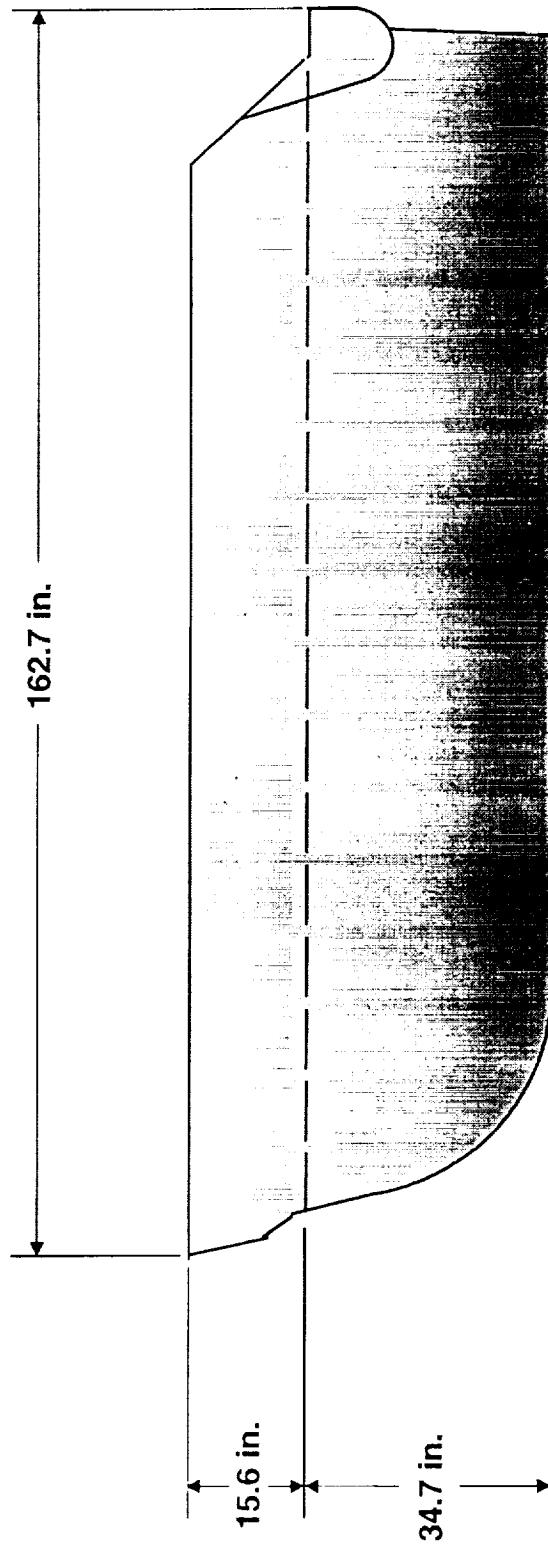
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- **Proposed approach**

- Analytical
 - Use parametric design techniques with Finite Element Analysis to determine blend radii required to reduce localized stresses for storage, transportation and launch
 - Ballistic predictions will ensure that the ballistics, ignition transient, and Block Model have not been adversely affected (including mass properties)
- Tooling
 - Define insulation configurations and tooling
 - Build pathfinder and checkout hardware
 - Define loaded segment design configurations and tooling
 - Fabricate tooling
 - Modify existing clevis and igniter mold rings
 - New stub fins and fin tip formers
 - Modify existing filler ring, fin puller, fin base spider and fin retainers
- Build and test
 - Build and test FSM-10 with new design (April 2002)
 - Determine flight effectiveness pending successful test evaluation
 - Implement first flight production (approx. November 2002)

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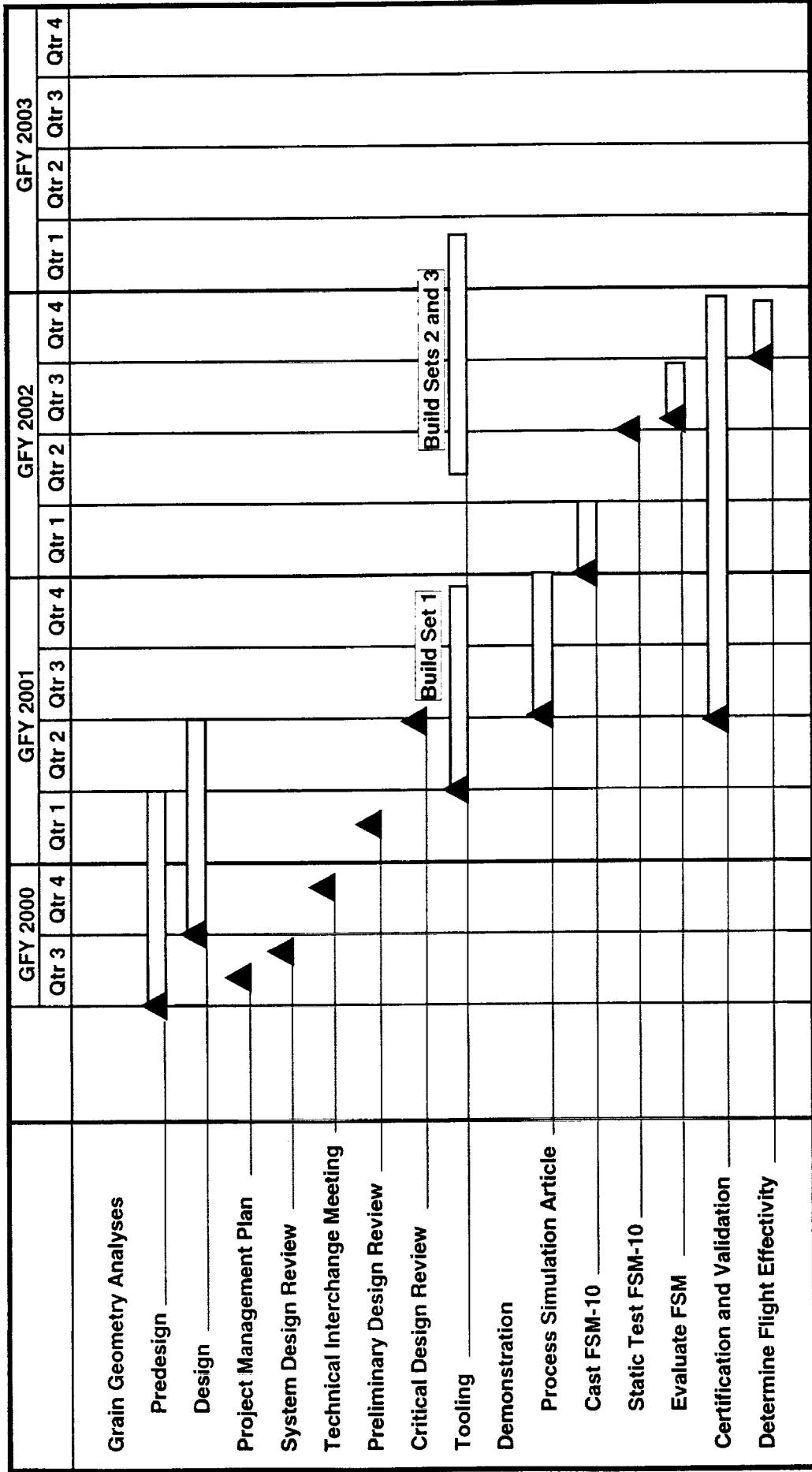
PRESENT DESIGN



Approximately 4 in. thick

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- End-to-end project - 3 years



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- Preliminary Req'ts Review Jun 28, 2000
- Preliminary Design Review Nov 15, 2000
- Critical Design Review Apr 2, 2001
- Static Test FSM-10 Apr 2002

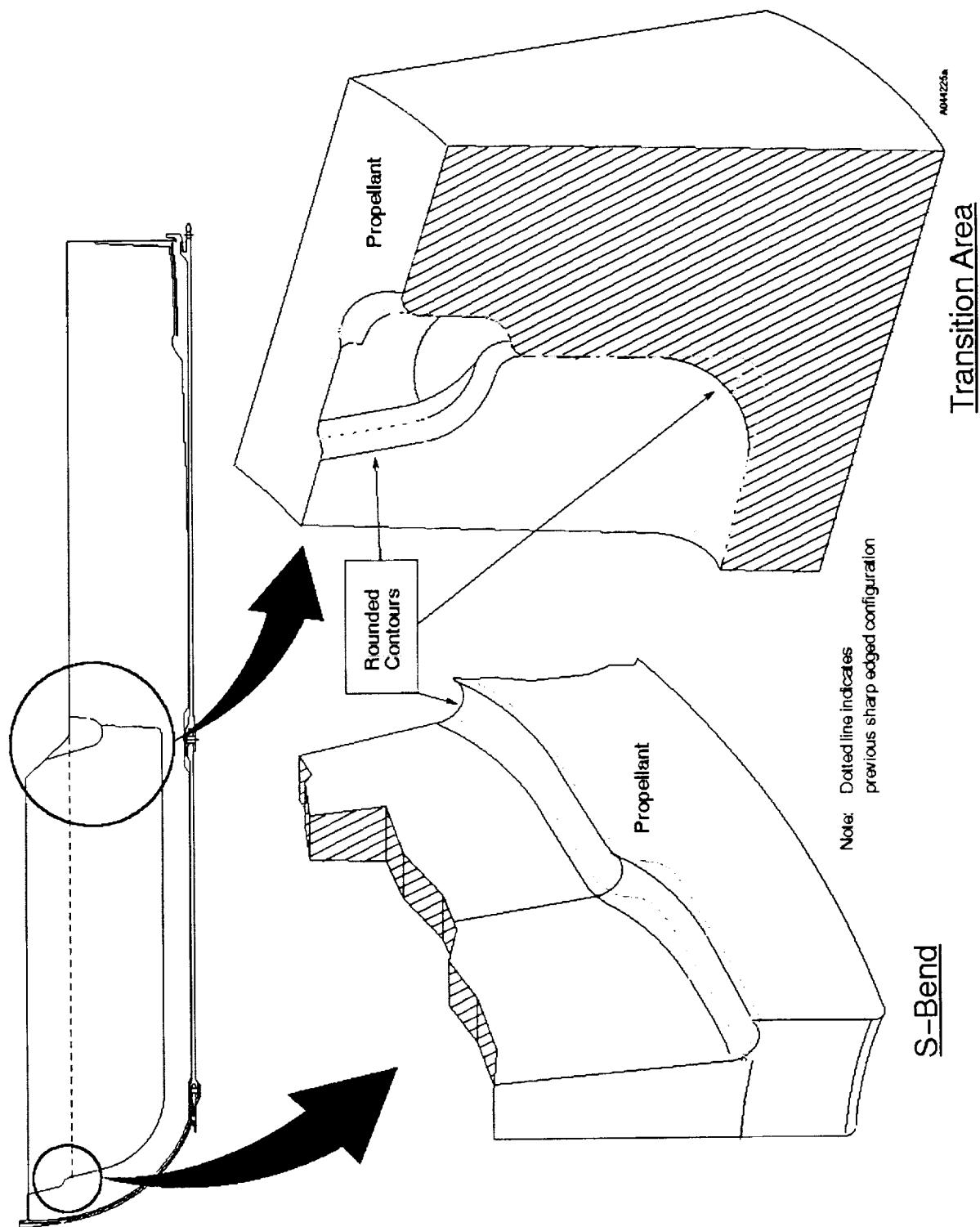
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- Summary
- The proposed upgrade will:
 - Enhance RSRM *SAFETY* and *RELIABILITY* by modifying the propellant grain geometry
 - Make the RSRM more robust
 - Increase the propellant structural factors of safety in forward and center segments by eliminating regions of concentrated stress
 - Improve personnel and system safety by eliminating operations in hazardous environments in the motor
 - Reduces propellant trimming
 - Eliminates re-inspections
 - Reduces segment handling, moves, and rotation
 - Increases schedule flexibility at KSC
- ***THE PAYBACK ON THIS UPGRADE IS IN ENHANCED PERSONNEL SAFETY AND MOTOR RELIABILITY***

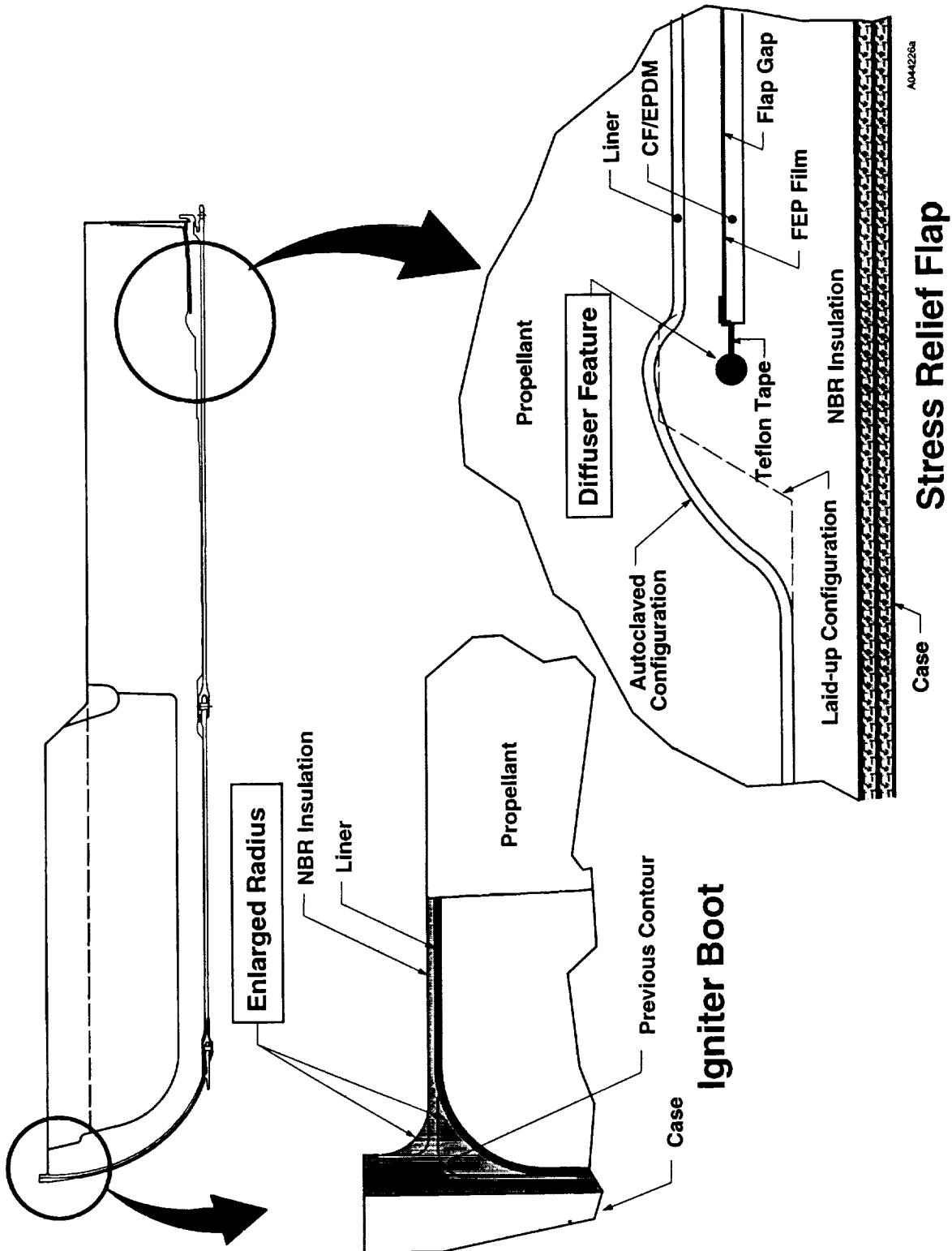
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Supporting Illustrations

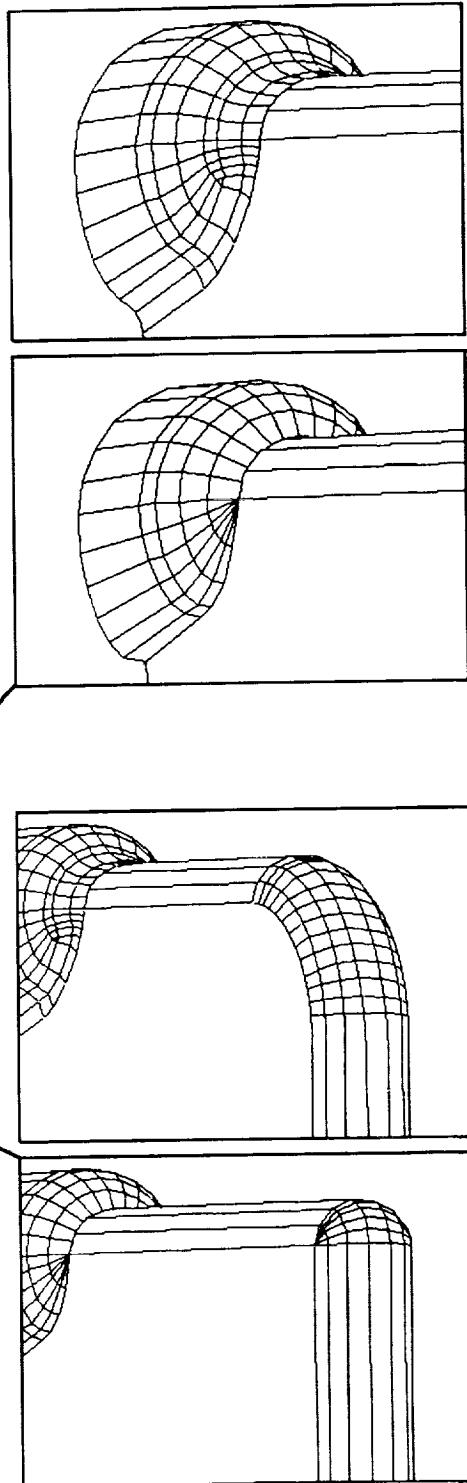
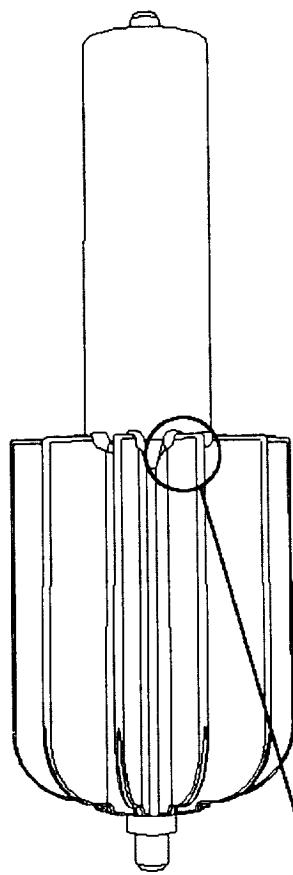
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Existing Proposed
Existing Proposed

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